



LM-79-19 TEST REPORT

for

P.Q.L., Inc.

2285 Ward Avenue / Simi Valley, CA 93065

LED Tube

Model: LT8U6H135C1

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ23120028a

The laboratory that conducted the testing detailed in this report has been accredited for SSL by NVLAP.

Review by:

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April Zou

Engineer: Wei Fei
Dec. 19, 2023

Manager: April Zou
Dec. 19, 2023

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

TEST SUMMARY

Tested Model	LT8U6H135C1 3000K Setting	LT8U6H135C1 4000K Setting	LT8U6H135C1 6500K Setting
Luminous Efficacy (Lumens /Watt)	127.5	136.3	134.3
Total Luminous Flux (Lumens)	1938.5	2039.7	2032.4
Power (Watts)/2	15.20	14.97	15.13
Power Factor	0.9974	0.9973	0.9972
CCT (K)	3019	3960	6307
CRI	83.6	86.5	83.8
Stabilization Time(Light & Power)	50 mins	50 mins	50 mins
Note	3000K	4000K	6500K

Table 1: Executive Data Summary

Test specifications:

Date of Receipt : Dec. 11, 2023

Date of Test : Dec. 16, 2023

Test item : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

Reference Standard : IESNA LM-79-2019 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

TABLE OF CONTENT

LM-79-19 TEST REPORT.....	1
TEST SUMMARY.....	2
SAMPLE PHOTO.....	5
TEST RESULTS (3000K Setting).....	6
Sphere-Spectroradiometer Method.....	6
Spectral Power Distribution - Sphere Spectroradiometer Method.....	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method.....	9
Color Rendition Report – Sphere Spectroradiometer Method.....	10
Goniophotometer Method.....	11
Zonal Lumen Tabulation- Goniophotometer Method.....	12
Illuminance Plots- Goniophotometer Method.....	13
Luminous Intensity Distribution Plots- Goniophotometer Method.....	14
Luminous Intensity Data- Goniophotometer Method.....	15
TEST RESULTS (4000K Setting).....	17
Sphere-Spectroradiometer Method.....	17
Spectral Power Distribution - Sphere Spectroradiometer Method.....	18
Chromaticity Diagram - Sphere Spectroradiometer Method.....	19
Nominal CCT Quadrangles – Sphere Spectroradiometer Method.....	20
Color Rendition Report – Sphere Spectroradiometer Method.....	21
TEST RESULTS (6500K Setting).....	22
Sphere-Spectroradiometer Method.....	22
Spectral Power Distribution - Sphere Spectroradiometer Method.....	23
Chromaticity Diagram - Sphere Spectroradiometer Method.....	24
Nominal CCT Quadrangles – Sphere Spectroradiometer Method.....	25
Color Rendition Report – Sphere Spectroradiometer Method.....	26
EQUIPMENT LIST.....	27



TEST METHODS	27
Seasoning of SSL Product.....	27
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	27
Goniophotometer Method	28
Photometric and Electrical Measurements	28
Color Characteristics Measurements.....	28

SAMPLE PHOTO

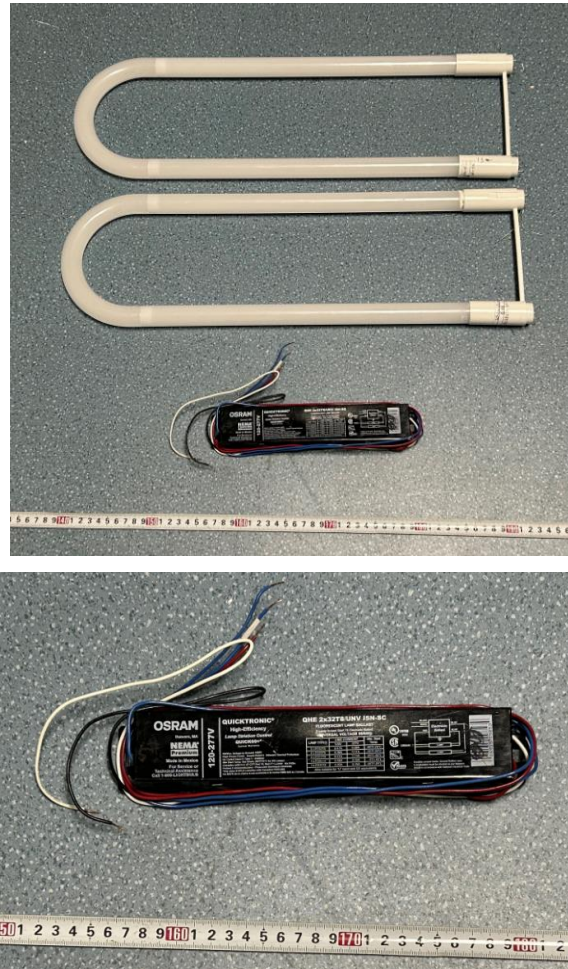


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: LT8U6H135C1
Electrical Ratings	: 120-277V, 50/60Hz, 15.5W
Product Description	: Color- Tunable 3000K/3500K/4000K/5000K/6500K LED Tubes supplied by a high frequency fluorescent lamp ballast: QHE 2x32T8/UNV ISN-SC
Manufacturer	: P.Q.L., Inc.
Address	: 2285 Ward Avenue / Simi Valley, CA 93065

TEST RESULTS (3000K Setting)

Test ambient temperature was 26.0°C.

Base orientation was base up. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 50 minutes, and the total operating time including stabilization was 55 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
	Test Voltage (V)	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.252	0.114
Power Factor	0.9974	0.9602
Test Power (W)/2	15.20	15.26
THD A%	4.90	10.12
Luminous Efficacy (lm/W)	127.5	127.0
Total Luminous Flux (lm)	1938.5	1938.0
Color Rendering Index (CRI)	83.6	
R9	11.9	
Correlated Color Temperature (CCT)(K)	3019	
Chromaticity Chroma x	0.4349	
Chromaticity Chroma y	0.4025	
Chromaticity Chroma u	0.2500	
Chromaticity Chroma v	0.3470	
Duv	-0.0004	
Chromaticity Chroma u'	0.2500	
Chromaticity Chroma v'	0.5205	

Special Color Rendering Indices	
R1	82.2
R2	91.5
R3	96.6
R4	81.7
R5	82.3
R6	89.6
R7	83.5
R8	61.1
R9	11.9
R10	80.4
R11	81.4
R12	71.1
R13	84.5
R14	98.8

Table 2: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u', v') diagram, $u' = u = 4x/(-2x+12y+3)$, $v' = 3v/2 = 9y/(-2x+12y+3)$.

Spectral Power Distribution - Sphere Spectroradiometer Method

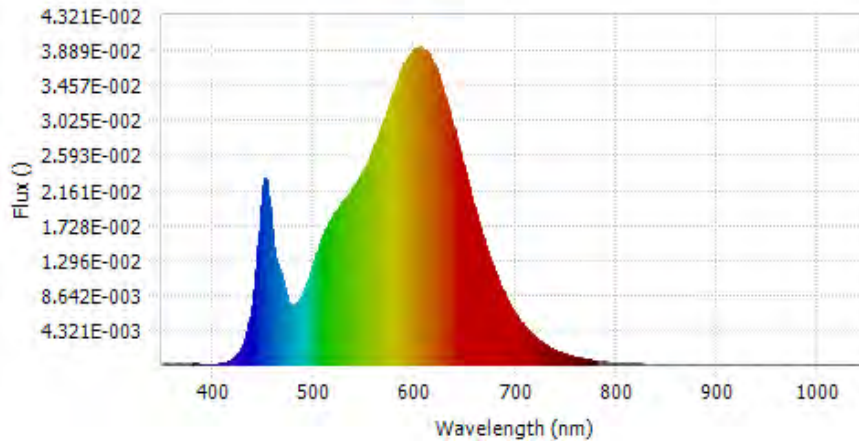
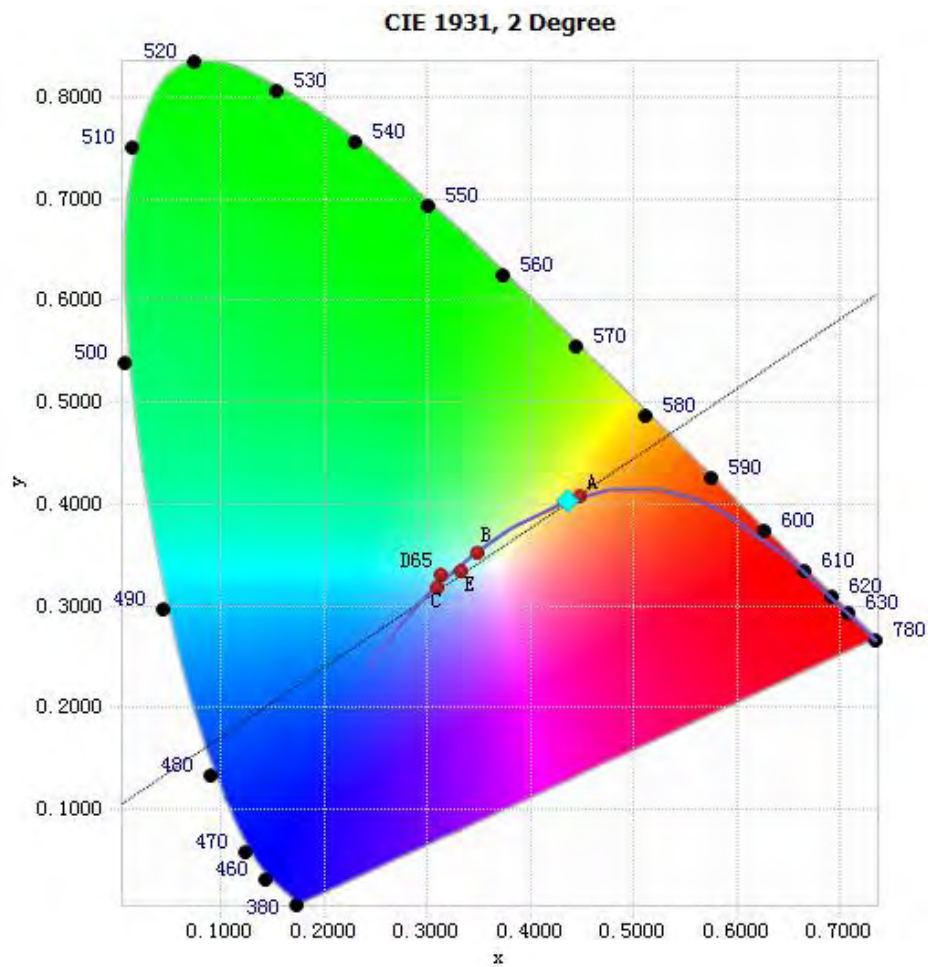


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.25E-04	485	7.93E-03	590	3.73E-02	695	7.30E-03
385	1.14E-04	490	8.99E-03	595	3.83E-02	700	6.24E-03
390	1.24E-04	495	1.06E-02	600	3.91E-02	705	5.32E-03
395	1.19E-04	500	1.26E-02	605	3.92E-02	710	4.55E-03
400	9.92E-05	505	1.45E-02	610	3.89E-02	715	3.90E-03
405	1.16E-04	510	1.61E-02	615	3.82E-02	720	3.35E-03
410	2.01E-04	515	1.76E-02	620	3.68E-02	725	2.86E-03
415	3.92E-04	520	1.85E-02	625	3.51E-02	730	2.43E-03
420	7.67E-04	525	1.96E-02	630	3.31E-02	735	2.07E-03
425	1.44E-03	530	2.04E-02	635	3.09E-02	740	1.76E-03
430	2.61E-03	535	2.11E-02	640	2.87E-02	745	1.50E-03
435	4.65E-03	540	2.20E-02	645	2.62E-02	750	1.28E-03
440	8.26E-03	545	2.31E-02	650	2.37E-02	755	1.09E-03
445	1.47E-02	550	2.41E-02	655	2.14E-02	760	9.37E-04
450	2.21E-02	555	2.55E-02	660	1.91E-02	765	7.98E-04
455	2.09E-02	560	2.69E-02	665	1.69E-02	770	6.80E-04
460	1.46E-02	565	2.85E-02	670	1.48E-02	775	5.79E-04
465	1.20E-02	570	3.03E-02	675	1.29E-02	780	5.01E-04
470	9.93E-03	575	3.22E-02	680	1.13E-02		
475	7.78E-03	580	3.40E-02	685	9.81E-03		
480	7.35E-03	585	3.59E-02	690	8.46E-03		

Table 3: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4349, 0.4025)

Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

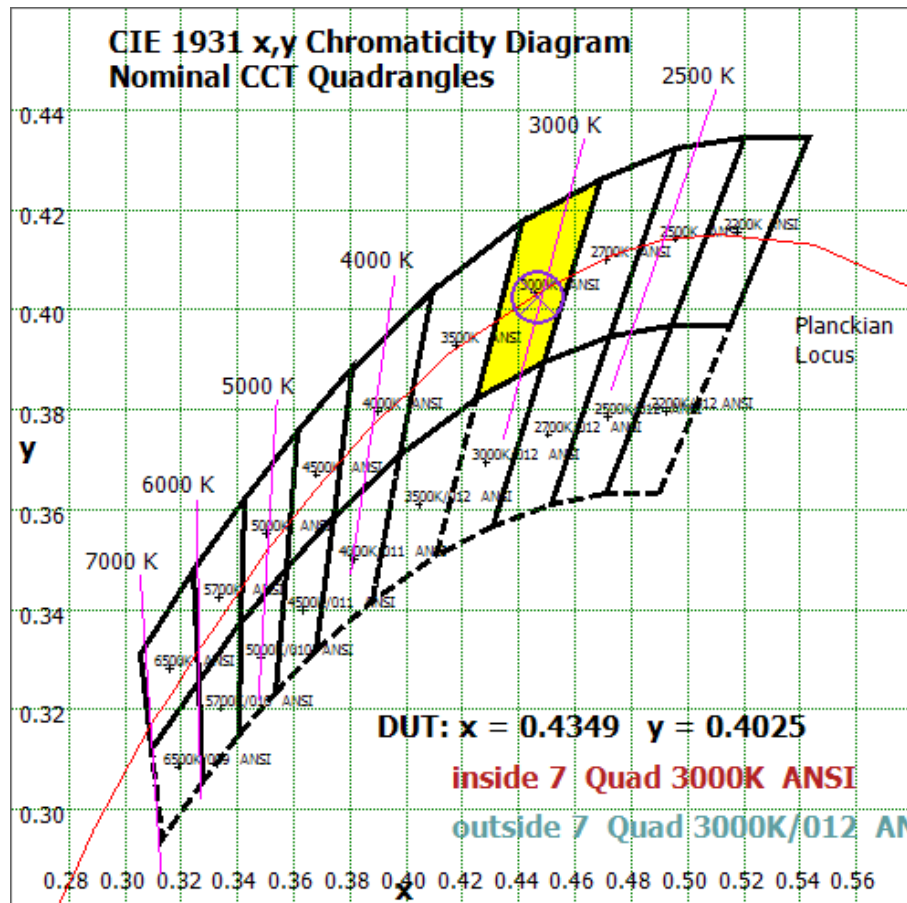


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

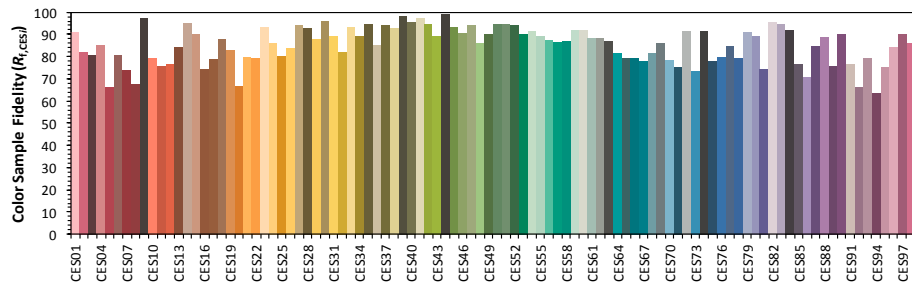
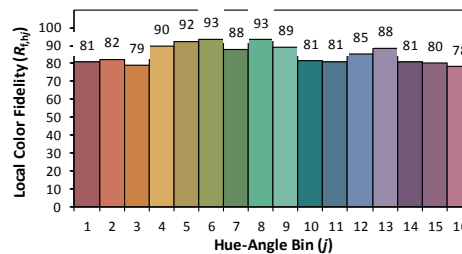
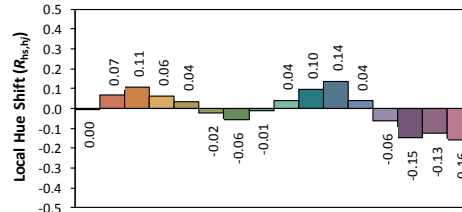
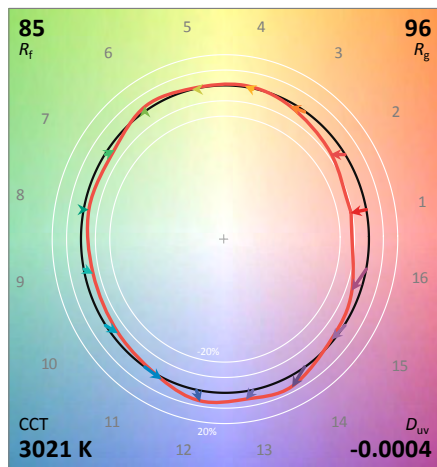
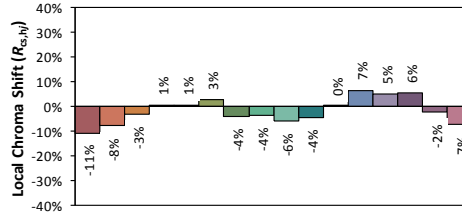
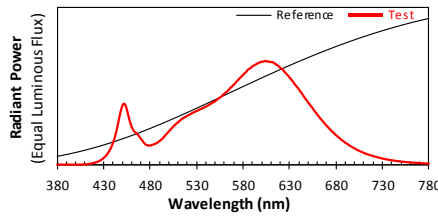
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: P.Q.L., Inc.

Date: 2023/12/16

Model: LT8U6H135C1



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.4349
 y 0.4025
 u' 0.2500
 v' 0.5205

CIE 13.3-1995 (CRI)	
R_a	84
R_g	12

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

Goniophotometer Method

Test ambient temperature was 25.0°C.

The photometric distance is 30 m.

Luminous data was taken at 0.5°vertical intervals and 10°horizontal intervals.

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.255
Power Factor	0.9969
Power (W)/2	15.23
Luminous Efficacy (lm/W)	128.4
Total Luminous Flux (lm)	1955.4
Beam Angle (°)	113.2 (0°-180°) / 167.2 (90°-270°)
Center Beam Candle Power (cd)	395
Maximum Beam Candle Power (cd)	395.8 (At: C=340.0, Gamma=2.5)
Spacing Criteria	1.21 (0°-180°) / 1.39 (90°-270°)
Zonal Lumens in the 0°-60°Zone	50.27%
Zonal Lumens in the 60°-90°Zone	27.44%
Zonal Lumens in the 90°-120°Zone	13.93%
Zonal Lumens in the 120°-180°Zone	8.35%

Table 4: Test data per Goniophotometer Method

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	37.461	1.92%
10- 20	108.181	5.53%
20- 30	167.161	8.55%
30- 40	208.727	10.67%
40- 50	230.055	11.77%
50- 60	231.29	11.83%
60- 70	215.317	11.01%
70- 80	187.357	9.58%
80- 90	133.967	6.85%
90-100	91.631	4.69%
100-110	100.483	5.14%
110-120	80.362	4.11%
120-130	61.571	3.15%
130-140	45.587	2.33%
140-150	30.041	1.54%
150-160	16.566	0.85%
160-170	7.511	0.38%
170-180	2.079	0.11%
Total	1955.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	982.875	50.27%
60- 90	536.641	27.44%
0-90	1519.52	77.71%
90- 180	435.831	22.29%
0- 180	1955.3	100%

Table 5: Zonal Lumen

Note: The Flux in this table might be a little different from the total flux in Table 2 due to rounding.

Illuminance Plots- Goniophotometer Method

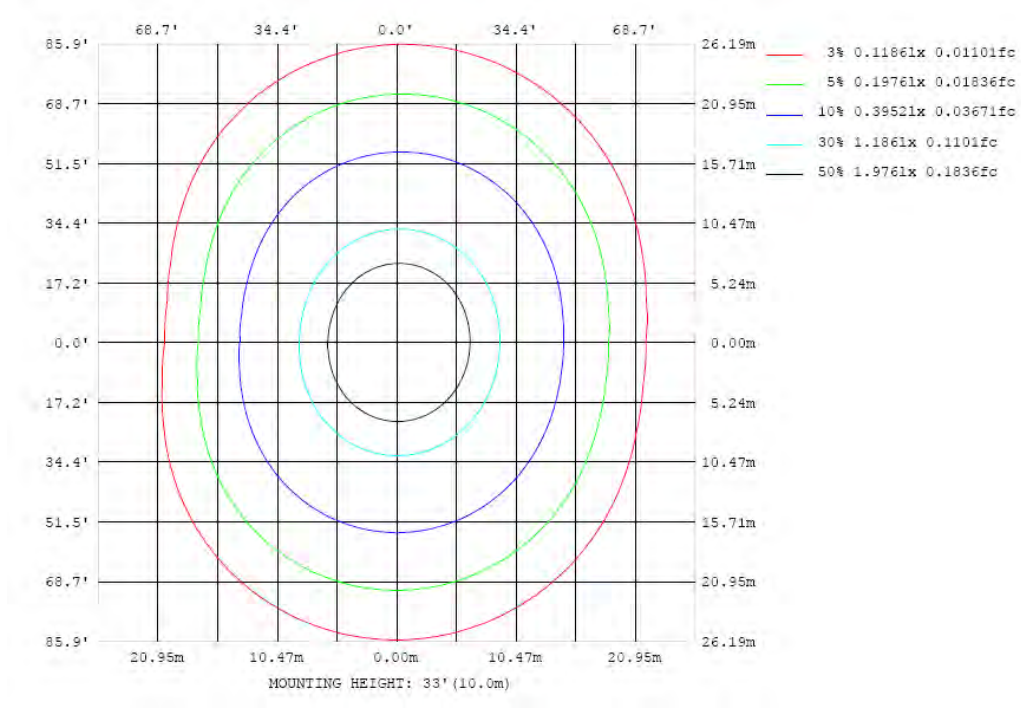


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

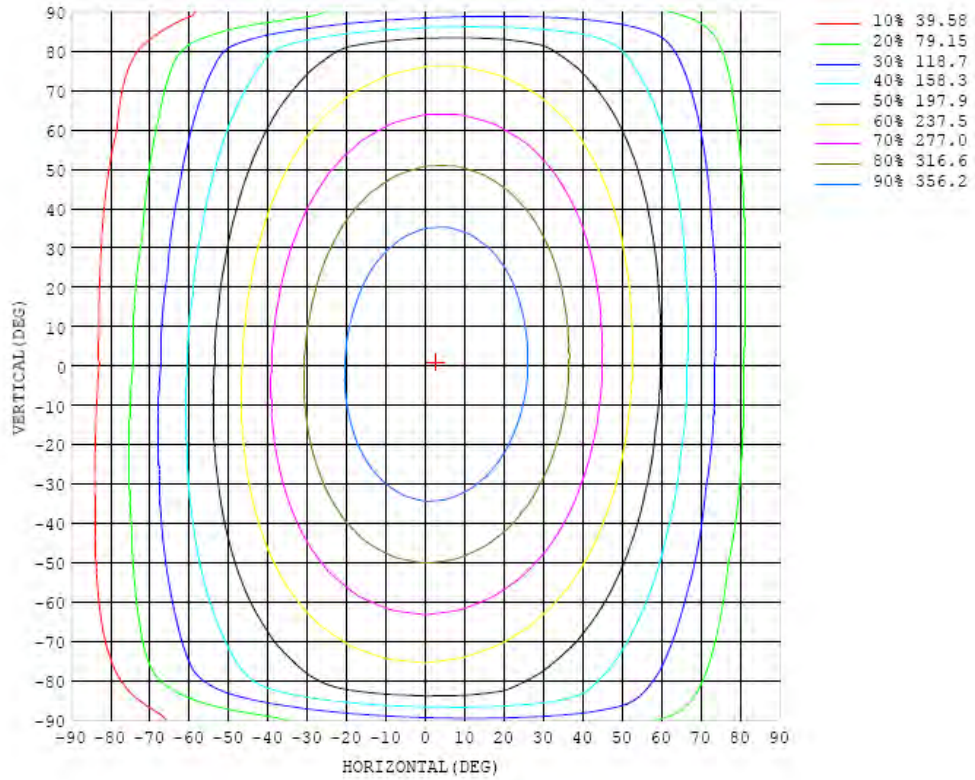


Chart 6: Isocandela Plot

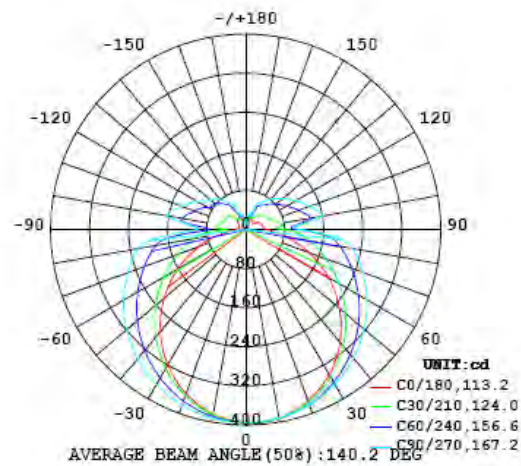


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395
5	395	395	395	395	395	395	395	395	395	394	394	394	393	393	392	392	391	391	391
10	392	392	392	392	392	392	392	392	392	392	391	390	389	388	386	385	384	384	383
15	384	384	385	385	386	387	388	388	388	387	386	385	383	380	378	376	374	373	372
20	373	374	374	376	377	379	381	382	382	382	380	378	375	371	367	364	361	359	358
25	359	360	361	363	366	369	372	374	374	374	372	369	365	360	355	349	345	342	340
30	342	343	345	348	352	357	361	364	365	365	363	359	354	347	340	333	327	322	320
35	323	323	326	330	336	342	348	352	355	355	353	348	341	333	324	314	306	300	297
40	301	301	305	311	319	326	334	339	343	343	341	336	327	317	306	295	284	277	272
45	277	277	282	290	299	309	318	325	330	331	328	322	313	301	287	273	261	251	246
50	251	252	258	267	279	291	302	310	315	317	314	308	297	284	268	252	237	225	218
55	224	225	233	244	258	272	285	294	300	302	300	292	281	266	248	230	212	198	190
60	196	197	207	221	237	253	267	278	285	287	284	277	265	248	229	208	188	171	161
65	167	169	180	197	216	234	249	261	268	271	269	261	248	231	210	187	164	144	132
70	138	141	154	174	195	215	231	244	252	255	253	245	231	213	191	167	141	119	103
75	110	113	131	153	176	196	214	227	235	239	237	228	215	197	174	148	121	94.3	75.6
80	83.4	87.2	108	133	157	178	196	210	219	222	220	212	198	180	157	131	102	72.9	51.8
85	59.9	64.8	87.6	114	136	158	172	180	184	183	179	170	159	144	127	108	82.4	54.2	32.8
90	43.1	46.3	61.5	77.7	91.2	101	108	112	113	111	105	96.0	85.3	73.6	61.3	48.3	33.6	18.3	10.2
95	38.6	39.3	54.2	71.4	83.8	94.0	101	107	111	112	111	108	103	97.1	89.0	77.3	52.6	30.5	12.9
100	36.6	37.2	49.3	72.0	96.3	118	136	147	153	156	157	153	142	125	102	76.7	51.4	30.5	13.9
105	35.0	35.0	45.3	65.0	87.2	108	127	139	147	151	150	143	133	117	95.5	71.9	48.5	30.0	15.9
110	34.4	33.7	42.4	59.4	79.3	98.9	116	129	136	139	138	133	123	108	88.4	67.0	46.3	30.0	15.0
115	32.9	33.2	40.3	54.9	72.6	90.4	106	118	126	129	128	123	113	99.6	82.0	62.9	44.7	30.4	15.4
120	29.3	30.6	39.0	51.4	66.9	82.7	97.1	108	115	118	117	113	104	92.0	76.4	59.6	44.0	27.0	14.4
125	23.3	25.9	37.8	49.0	62.2	75.7	88.7	98.7	105	108	107	103	95.9	85.1	71.6	57.1	43.8	25.9	17.4
130	20.3	23.2	30.6	47.7	58.1	69.7	80.9	90.1	96.0	98.5	97.9	94.5	88.2	79.1	67.5	55.3	43.2	25.3	20.7
135	20.7	24.0	31.1	45.6	54.2	63.9	74.3	82.1	87.3	89.8	89.4	86.5	81.2	73.7	64.1	54.4	33.4	24.4	24.2
140	21.6	24.4	26.4	35.1	51.0	58.1	66.7	75.0	79.4	81.7	81.6	79.4	75.2	69.0	60.6	50.1	34.5	24.1	24.7
145	21.1	23.6	26.5	31.2	47.1	54.8	61.5	66.9	69.5	71.5	71.3	69.2	65.9	63.2	56.9	36.8	27.4	25.1	26.1
150	22.0	24.2	25.4	26.6	33.1	50.3	57.5	61.6	63.9	65.2	64.9	63.5	59.9	52.9	33.6	32.4	28.8	24.8	26.2
155	23.9	26.0	25.5	27.1	28.3	31.0	44.4	55.7	57.8	60.0	59.8	57.5	53.9	37.4	34.4	31.1	24.2	21.8	25.2
160	25.3	24.4	24.2	26.5	27.1	29.6	33.4	31.9	35.5	36.6	37.0	35.2	31.2	34.7	32.3	29.3	27.1	25.3	26.0
165	24.9	26.1	23.6	24.2	26.1	28.0	29.3	28.8	29.7	31.8	32.1	30.0	29.5	30.7	29.5	26.8	24.9	26.0	30.2
170	22.6	20.7	22.9	20.5	23.2	25.2	25.9	26.5	27.6	28.0	28.1	28.1	27.5	26.2	26.2	27.1	25.1	26.9	27.2
175	16.6	17.1	18.5	19.7	19.3	19.4	21.5	24.2	25.9	26.0	26.0	25.7	25.3	24.9	24.6	25.5	27.0	26.0	22.4
180	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395		
5	391	391	392	392	393	393	393	394	394	395	395	395	395	395	395	395	395		
10	383	384	385	386	387	389	390	391	392	393	393	393	393	393	392	392	392		
15	372	373	375	377	380	382	384	386	388	388	389	389	388	387	386	385	384		
20	358	360	362	366	369	373	377	380	382	383	383	382	381	379	377	375	374		
25	340	343	347	352	357	363	368	372	375	376	376	375	372	369	365	362	360		
30	320	323	329	336	343	351	358	363	366	367	367	365	361	356	351	347	344		
35	298	302	309	318	328	337	346	352	356	357	356	353	348	342	335	329	324		
40	273	278	287	299	311	322	332	340	345	346	344	340	333	325	317	309	303		
45	247	253	265	278	293	307	318	327	332	334	331	326	317	308	297	287	280		
50	220	228	241	257	274	290	303	313	319	320	317	310	301	289	276	264	255		
55	191	201	217	236	255	273	288	298	304	306	302	294	283	269	255	241	229		
60	163	175	193	215	236	256	272	283	289	290	286	277	265	250	233	216	203		
65	134	148	171	195	218	239	255	267	273	274	270	260	247	230	211	192	176		
70	105	123	149	175	200	221	239	251	257	258	253	243	229	211	190	168	149		
75	78.6	100	128	157	182	204	222	234	241	241	236	226	211	192	170	146	123		
80	55.5	79.6	109	139	165	187	205	218	224	224	219	208	193	173	151	125	100.0		
85	37.0	59.8	88.0	110	126	140	154	165	173	177	177	174	166	152	130	105	79.4		
90	11.9	22.3	36.9	54.3	62.6	74.3	85.5	94.3	100	103	104	102	97.6	90.6	81.3	68.8	55.4		
95	15.2	35.3	59.5	86.1	98.6	107	113	117	119	118	115	110	103	93.5	82.2	68.2	47.0		
100	16.5	33.2	56.1	83.9	109	132	148	159	164	164	158	147	131	110	87.0	63.5	43.2		
105	18.3	32.5	52.8	77.7	100	122	138	148	153	153	147	136	119	100	78.3	57.0	40.5		
110	20.4	33.3	49.4	71.2	93.3	110	125	135	140	140	135	124	109	90.0	70.1	53.1	37.8		
115	18.1	33.0	48.8	62.6	83.6	103	115	123	127	127	122	112	98.0	81.9	65.4	49.4	36.2		
120	15.3	33.0	47.8	64.2	74.8	90.0	104	113	116	116	111	102	90.2	75.6	60.1	46.3	33.0		
125	17.2	28.2	46.2	61.5	74.6	86.7	90.2	98.4	104	104	99.7	91.6	82.3	69.9	57.0	41.0	26.0		
130	18.0	22.1	44.2	59.1	70.7	81.6	87.7	93.4	96.2	95.7	92.1	85.0	75.9	64.8	51.7	37.6	24.8		
135	20.4	21.8	39.9	55.4	66.6	75.7	82.2	86.9	89.0	88.4	84.9	78.5	69.7	57.1	44.4	32.8	23.3		
140	19.2	21.6	25.2	47.1	59.7	68.7	75.3	79.2	81.1	80.7	77.0	68.6	59.3	51.7	39.8	26.2	23.0		
145	20.9	21.1	29.0	32.9	53.3	61.8	62.1	66.3	69.9	69.3	64.8	60.0	54.1	43.8	29.2	25.7	22.6		
150	26.2	22.0	22.3	27.4	30.3	49.1	57.9	60.8	62.1	62.2	60.1	56.1	47.0	31.0	28.6	24.3	21.8		
155	29.1	24.9	22.5	23.1	30.3	30.9	34.7	48.4	54.0	53.6	45.9	32.8	31.8	30.4	23.1	21.8	20.6		
160	26.9	21.6	20.2	24.0	26.3	26.8	34.8	34.6	32.0	32.2	34.1	33.1	25.8	26.1	24.1	20.5	21.1		
165	25.3	21.7	21.8	21.6	23.8	24.0	25.7	27.5	28.3	28.2	26.9	25.7	23.3	22.0	19.2	19.5	22.3		
170	24.9	19.4	21.8	23.6	20.2	22.8	24.1	24.5	22.7	22.6	22.8	21.3	19.3	16.8	17.7	19.6	21.7		
175	19.1	18.9	16.5	15.3	16.9	18.0	20.3	20.6	19.9	20.5	17.1	16.2	15.5	15.5	16.6	18.4	17.8		
180	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8		

Table 7: Luminous Intensity Data

TEST RESULTS (4000K Setting)

Test ambient temperature was 26.0°C.

Base orientation was base up. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 50 minutes, and the total operating time including stabilization was 55 minutes.

Sphere-Spectroradiometer Method

Parameter	Result		Special Color Rendering Indices	
Test Voltage (V)	120.0	277.0	R1	86.3
Voltage frequency (Hz)	60	60	R2	93.8
Test Current (A)	0.249	0.112	R3	96.1
Power Factor	0.9973	0.9592	R4	84.2
Test Power (W)/2	14.97	15.04	R5	85.7
THD A%	5.23	9.77	R6	89.6
Luminous Efficacy (lm/W)	136.3	135.6	R7	86.5
Total Luminous Flux (lm)	2039.7	2039.5	R8	69.6
Color Rendering Index (CRI)	86.5		R9	26.1
R9	26.1		R10	83.8
Correlated Color Temperature (CCT)(K)	3960		R11	83.8
Chromaticity Chroma x	0.3804		R12	64.2
Chromaticity Chroma y	0.3717		R13	88.8
Chromaticity Chroma u	0.2271		R14	98.6
Chromaticity Chroma v	0.3329			
Duv	-0.0024			
Chromaticity Chroma u'	0.2271			
Chromaticity Chroma v'	0.4993			

Table 8: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u',v') diagram, $u' = u = 4x/(-2x+12y+3)$, $v' = 3v/2 = 9y/(-2x+12y+3)$.

Spectral Power Distribution - Sphere Spectroradiometer Method

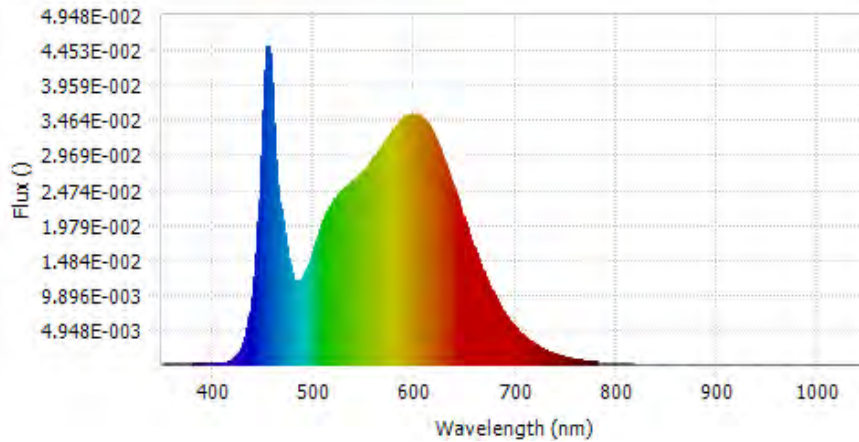
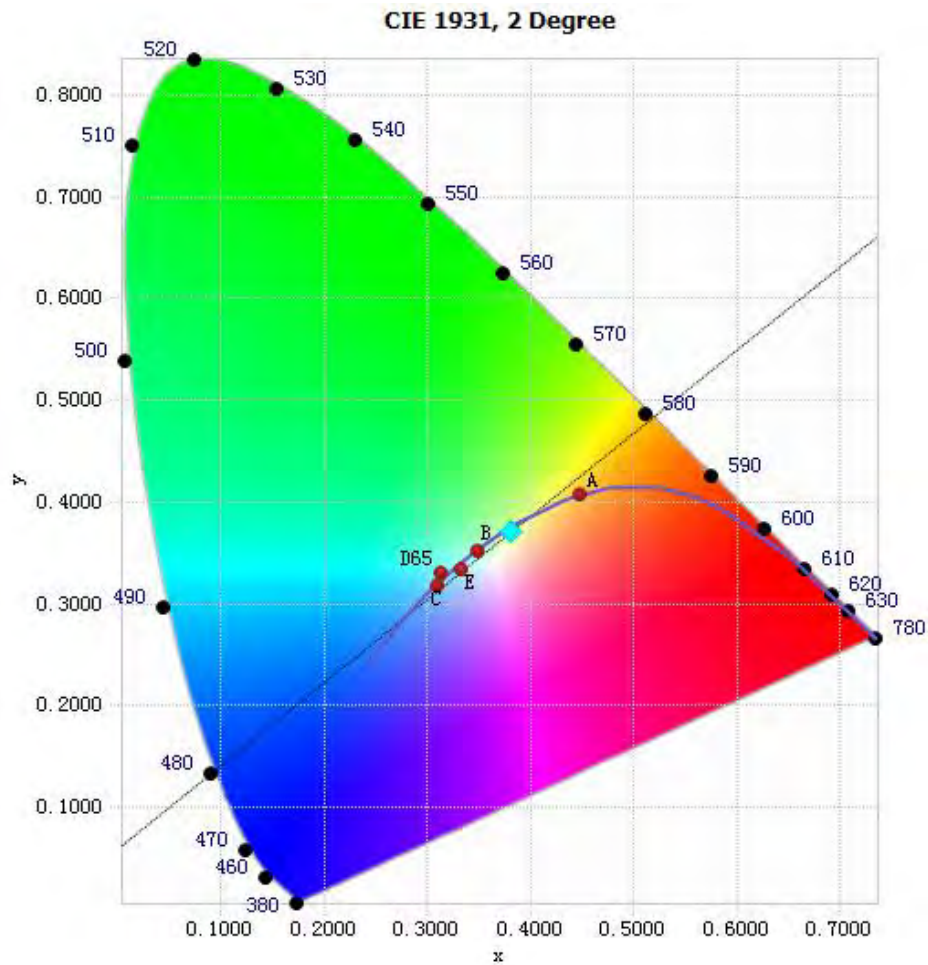


Chart 8: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.86E-04	485	1.18E-02	590	3.52E-02	695	6.13E-03
385	1.83E-04	490	1.27E-02	595	3.55E-02	700	5.25E-03
390	1.80E-04	495	1.42E-02	600	3.56E-02	705	4.49E-03
395	1.74E-04	500	1.64E-02	605	3.52E-02	710	3.84E-03
400	1.60E-04	505	1.87E-02	610	3.45E-02	715	3.29E-03
405	1.61E-04	510	2.06E-02	615	3.36E-02	720	2.84E-03
410	2.23E-04	515	2.23E-02	620	3.21E-02	725	2.42E-03
415	4.25E-04	520	2.32E-02	625	3.05E-02	730	2.05E-03
420	8.40E-04	525	2.42E-02	630	2.85E-02	735	1.75E-03
425	1.62E-03	530	2.50E-02	635	2.65E-02	740	1.49E-03
430	3.12E-03	535	2.55E-02	640	2.45E-02	745	1.27E-03
435	5.91E-03	540	2.62E-02	645	2.23E-02	750	1.09E-03
440	1.10E-02	545	2.69E-02	650	2.01E-02	755	9.26E-04
445	2.03E-02	550	2.75E-02	655	1.82E-02	760	7.98E-04
450	3.60E-02	555	2.84E-02	660	1.61E-02	765	6.85E-04
455	4.50E-02	560	2.93E-02	665	1.43E-02	770	5.82E-04
460	3.43E-02	565	3.03E-02	670	1.25E-02	775	4.99E-04
465	2.40E-02	570	3.14E-02	675	1.09E-02	780	4.31E-04
470	1.96E-02	575	3.25E-02	680	9.50E-03		
475	1.50E-02	580	3.35E-02	685	8.25E-03		
480	1.21E-02	585	3.46E-02	690	7.12E-03		

Table 9: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3804, 0.3717)

Chart 9: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

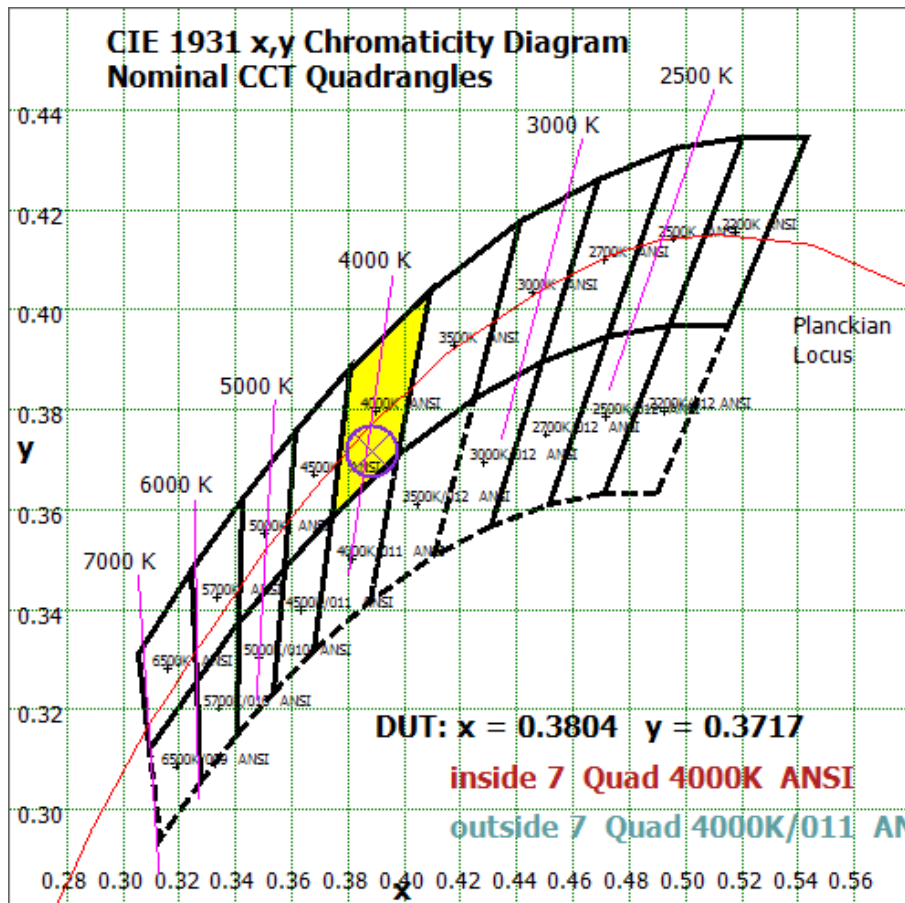


Chart 10: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

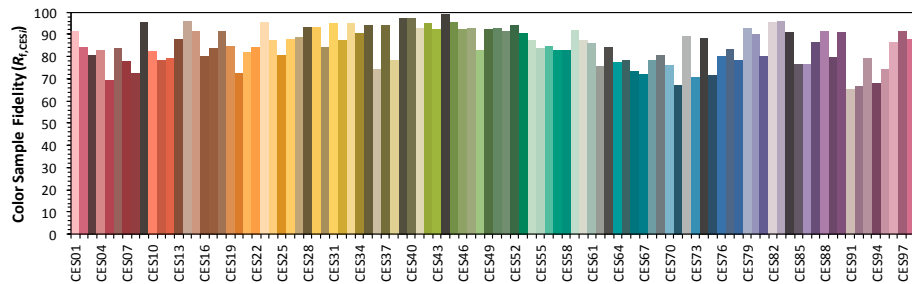
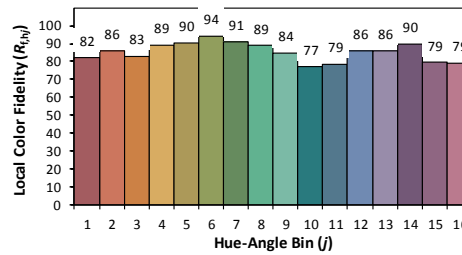
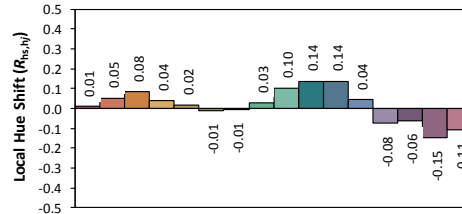
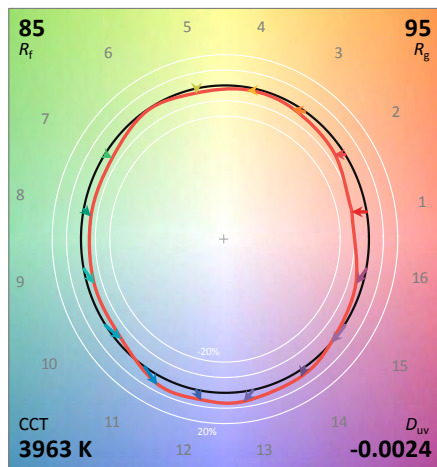
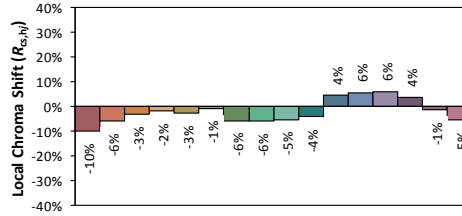
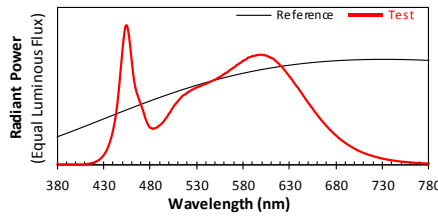
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: P.Q.L., Inc.

Date: 2023/12/16

Model: LT8U6H135C1



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.3804
 y 0.3717
 u' 0.2271
 v' 0.4993

CIE 13.3-1995 (CRI)	
R_a	87
R_g	26

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

Chart 11: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 8 due to rounding.

TEST RESULTS (6500K Setting)

Test ambient temperature was 26.0°C.

Base orientation was base up. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 50 minutes, and the total operating time including stabilization was 55 minutes.

Sphere-Spectroradiometer Method

Parameter	Result		Special Color Rendering Indices	
Test Voltage (V)	120.0	277.0	R1	82.2
Voltage frequency (Hz)	60	60	R2	89.7
Test Current (A)	0.251	0.113	R3	92.7
Power Factor	0.9972	0.9598	R4	81.5
Test Power (W)/2	15.13	15.19	R5	81.7
THD A%	5.03	10.20	R6	83.8
Luminous Efficacy (lm/W)	134.3	133.8	R7	88.5
Total Luminous Flux (lm)	2032.4	2032.9	R8	70.5
Color Rendering Index (CRI)	83.8		R9	12.7
R9	12.7		R10	74.1
Correlated Color Temperature (CCT)(K)	6307		R11	80.6
Chromaticity Chroma x	0.3156		R12	54.3
Chromaticity Chroma y	0.3348		R13	84.8
Chromaticity Chroma u	0.1977		R14	96.4
Chromaticity Chroma v	0.3146			
Duv	0.0047			
Chromaticity Chroma u'	0.1977			
Chromaticity Chroma v'	0.4718			

Table 10: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u',v') diagram, $u' = u = 4x/(-2x+12y+3)$, $v' = 3v/2 = 9y/(-2x+12y+3)$.

Spectral Power Distribution - Sphere Spectroradiometer Method

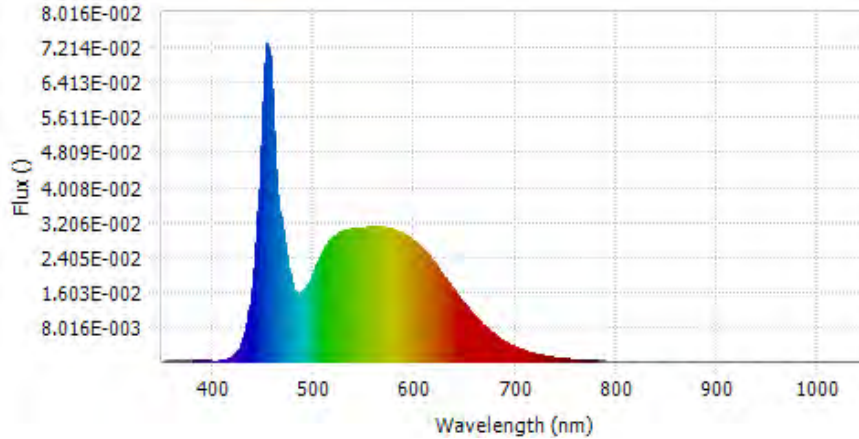
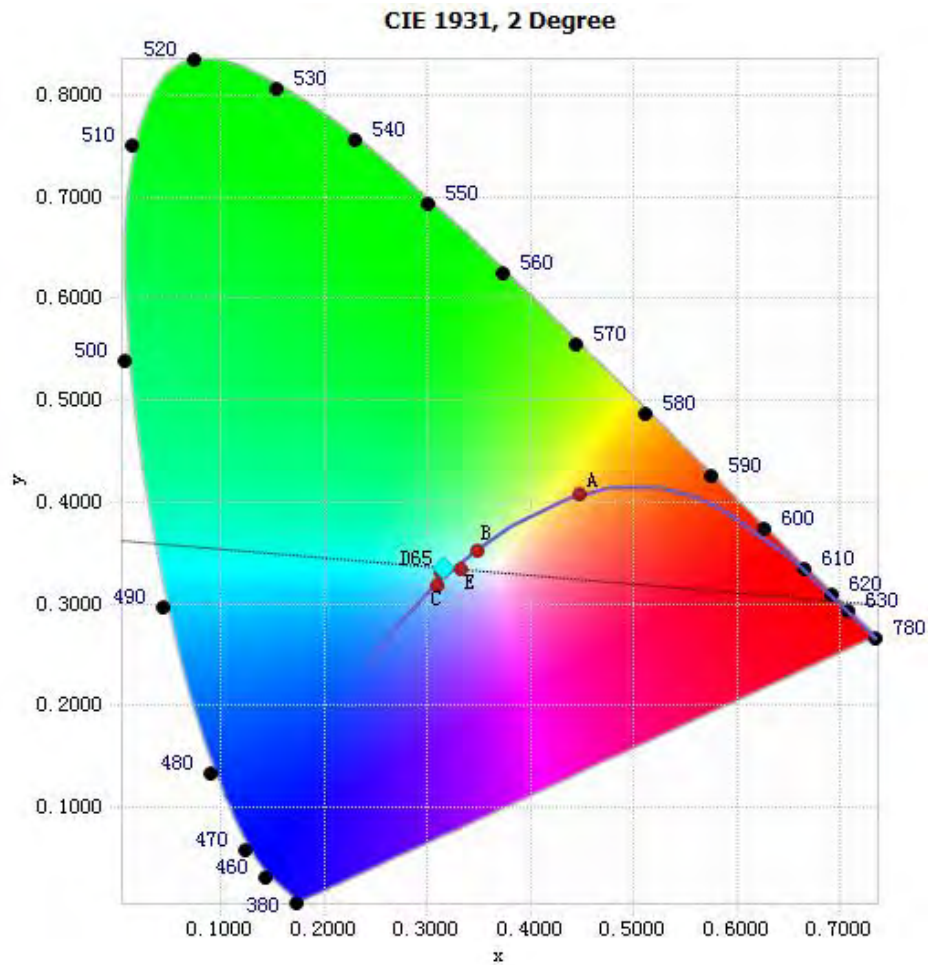


Chart 12: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.57E-04	485	1.57E-02	590	2.93E-02	695	3.88E-03
385	2.44E-04	490	1.64E-02	595	2.84E-02	700	3.32E-03
390	2.54E-04	495	1.80E-02	600	2.75E-02	705	2.85E-03
395	2.35E-04	500	2.06E-02	605	2.64E-02	710	2.44E-03
400	2.16E-04	505	2.34E-02	610	2.51E-02	715	2.10E-03
405	2.02E-04	510	2.57E-02	615	2.38E-02	720	1.81E-03
410	3.10E-04	515	2.77E-02	620	2.23E-02	725	1.55E-03
415	6.38E-04	520	2.86E-02	625	2.08E-02	730	1.32E-03
420	1.31E-03	525	2.96E-02	630	1.91E-02	735	1.13E-03
425	2.73E-03	530	3.01E-02	635	1.75E-02	740	9.68E-04
430	5.35E-03	535	3.03E-02	640	1.60E-02	745	8.31E-04
435	1.03E-02	540	3.06E-02	645	1.45E-02	750	7.13E-04
440	1.90E-02	545	3.08E-02	650	1.30E-02	755	6.10E-04
445	3.44E-02	550	3.07E-02	655	1.16E-02	760	5.30E-04
450	5.97E-02	555	3.09E-02	660	1.03E-02	765	4.51E-04
455	7.23E-02	560	3.09E-02	665	9.05E-03	770	3.91E-04
460	5.30E-02	565	3.09E-02	670	7.91E-03	775	3.38E-04
465	3.61E-02	570	3.08E-02	675	6.91E-03	780	2.90E-04
470	2.89E-02	575	3.06E-02	680	6.01E-03		
475	2.14E-02	580	3.03E-02	685	5.21E-03		
480	1.65E-02	585	3.00E-02	690	4.50E-03		

Table 11: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3156, 0.3348)

Chart 13: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

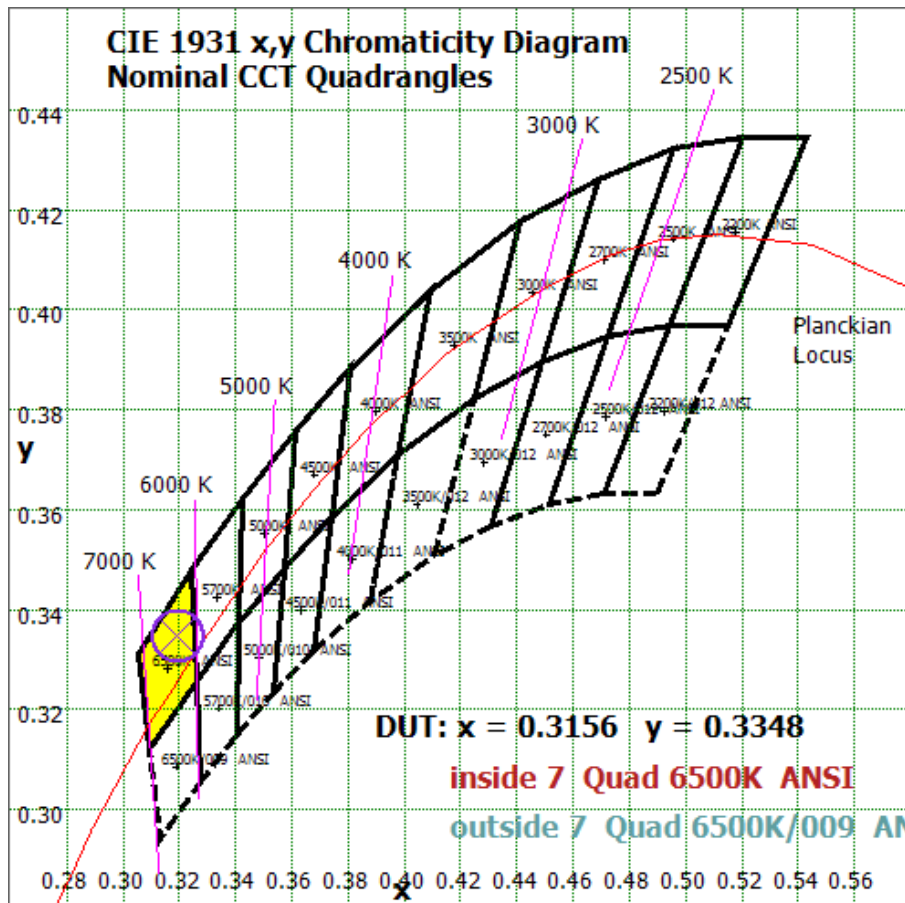


Chart 14: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

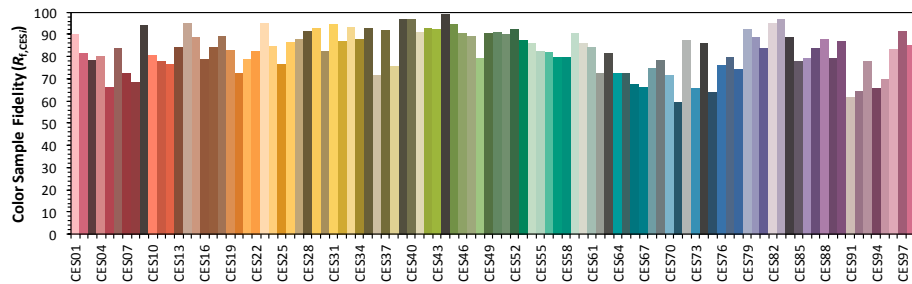
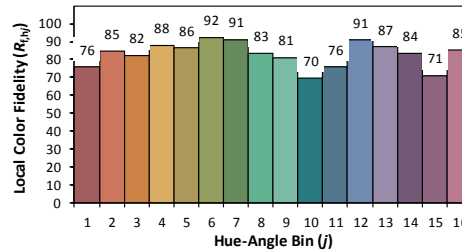
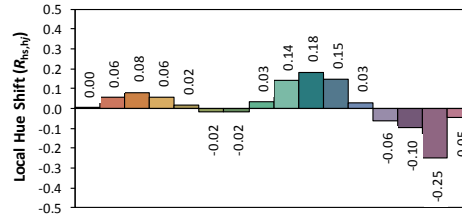
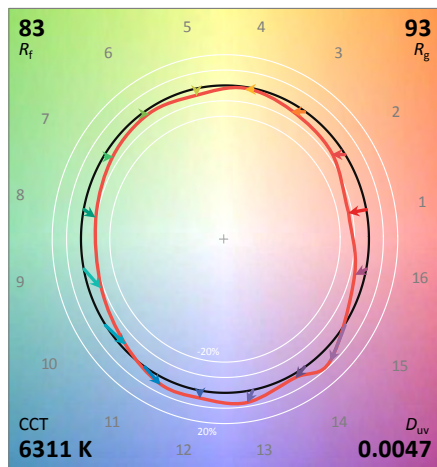
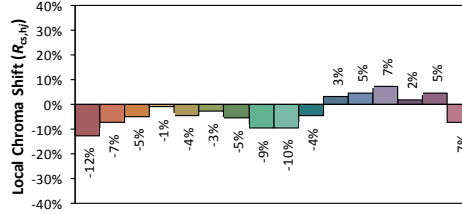
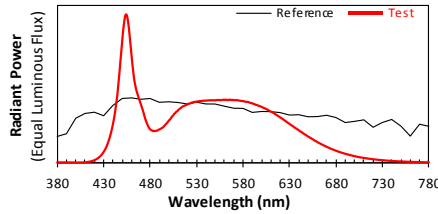
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: P.Q.L., Inc.

Date: 2023/12/16

Model: LT8U6H135C1



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.3156
 y 0.3348
 u' 0.1977
 v' 0.4718

CIE 13.3-1995 (CRI)	
R_a	84
R_g	13

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

Chart 15: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 10 due to rounding.

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jun. 05, 2023	-
Digital Power Meter	PF2010A	HZTE028-01	Aug. 01, 2023	Jul. 31, 2024
AC Power Supply	DPS1060	HZTE001-06	Aug. 01, 2023	Jul. 31, 2024
DC Power Supply	WY12010	HZTE004-03	Aug. 01, 2023	Jul. 31, 2024
Temperature recorder	JM624U	HZTE018-08	Aug. 04, 2023	Aug. 03, 2024
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 04, 2023	Aug. 03, 2024
Standard source	D908	HZTE012-01	Aug. 14, 2018	-
Integrate Sphere system	3M	HZTE015-04	Jul. 24, 2023	-
Digital Power Meter	WT210	HZTE008-01	Aug. 01, 2023	Jul. 31, 2024
AC Power Supply	PCR 500L	HZTE001-07	Aug. 01, 2023	Jul.31, 2024
DC Power Supply	IT6154	HZTE004-04	Aug. 01, 2023	Jul. 31, 2024
Standard source	SCL-1400	HZTE012-06	Nov. 04, 2021	-
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 04, 2023	Aug. 03, 2024
Temperature Meter	TES1310	HZTE017-01	Aug. 04, 2023	Aug. 03, 2024

Table 12: Test Equipment List

TEST METHODS

Seasoning of SSL Product

For the purpose of rating new SSL products, SSL products shall be tested with no seasoning. Therefore, no seasoning was performed.

Sphere-Spectroradiometer Method- Photometric and Electrical Measurements

A Labsphere Model CDS 2100 Spectroradiometer and 3 Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit. The coating reflectance of each sphere is 98%. The measure geometry is 4π . Self-absorption correction is conducted in testing. Bandwidth of spectroradiometer is 350nm-1050nm.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 20 min, taken 10 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

The standard reference of the integrated sphere system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Standards and Technology.

The uncertainty of integrating sphere system reported in this document is expanded uncertainty is 2.1% with a coverage factor $k=2$.

Goniophotometer Method

Photometric and Electrical Measurements

An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.

Ambient temperature was measured at the same height of the sample mounted on the Goniophotometer equipment. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 20 min, taken 10 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Everfine Digital Power Meter.

Some graphics were created with Photometric Plus software.

The standard reference of the Goniophotometer system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Metrology P.R. China.

The uncertainty of goniophotometer system reported in this document is expanded uncertainty is 2.3% with a coverage factor $k=2$.

Color Characteristics Measurements

The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as values that are spatially average, weighted to intensity, over the angular range where light is intentionally emitted from the SSL product. The color characteristics measurements are using gonio-spectroradiometer.

*** End of Report ***

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.